

THE INCIDENCE OF INTESTINAL PARASITES, ESPECIALLY WITH REGARD TO THE PROTOZOA, AMONGST SYMPTOMLESS CARRIERS IN JAMAICA.

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(Received for publication 13 April, 1921)

The objects of this investigation were, firstly, to find out the incidence of infection with various species of intestinal parasites in patients admitted to hospital for conditions totally unconnected with dysentery or other intestinal complaints, *i.e.*, symptomless carriers, and, secondly, to see what strains of amoebae were common.

That three successive examinations should indicate freedom from infection was a purely arbitrary standard, and is shown later to be erroneous in some at least of the cases in this series.

We must bear in mind that a 'negative examination' does not mean that no cysts are present; it, of course, merely implies that none have been found, and, when we consider how small a proportion of the whole stool is submitted to examination, we can understand that if the cysts are few in number they may easily be missed in such a limited examination. Again, if only one or two are found after thorough examination of several specimens, though the results will be erroneous from the statistical point of view if put down as negative, owing to none being found in the first three specimens, nevertheless the infection is probably so slight that for all practical purposes the stool is negative.

In this connection, however, it is also important to remember that the value of a negative report on examination will differ somewhat according to the species of parasite. Thus, a negative examination in respect of *Giardia intestinalis* is more likely to be correct, as

regards inference, than one in respect of *Entamoeba coli*, owing to the more general and even distribution of the former in a stool; while the latter are often so irregularly distributed through the faeces that one sample taken for examination is by no means representative of the whole stool. Under conditions such as the latter, two observers examining different portions of the same stool might give diametrically opposite reports: the one that he could not find any, the other that *coli* cysts were abundant. In cases of *Giardia* infection this is less likely to occur.

In order to minimise this difficulty as far as was practicable, instead of taking these specimens from a stool and examining direct, I have adopted the concentration method of Cropper and Row (1917). By this means, not only was the examination facilitated, but one was able to employ larger quantities for examination, and, by the prolonged shaking and consequently more thorough emulsification, to obtain specimens more representative of the general state of the stool.

A second branch of investigation was also undertaken, as the opportunity to add something to the knowledge of the size of cysts in different persons infected was too good to be lost. All who have undertaken the measurement of a large number of cysts of the various parasites will appreciate the tediousness and labour involved in doing this day after day, but it appeared to me that it would be a matter of interest and possible utility to see whether the researches of Matthews and Malins Smith (1917) in Liverpool cases were corroborated by the findings in patients in Jamaica.

With a pressure of routine work, and having no trained assistants, I have been able to deal with a limited number of cases only, very limited indeed as compared with the large numbers examined and reported upon by the two authors mentioned, and in putting forward my results, I do so with a feeling of diffidence, since, owing to the limited time and resources at my disposal, I do not intend them as a comparison with their brilliant work.

The remarks which follow, however, will serve as a good basis for further investigation which can be continued at any time, and also as a basis for comparison with similar cases in other tropical countries.

The method which has been employed is as follows:—Cases for

examination were selected from among patients in the hospital to which the laboratory is attached. Those patients who had been admitted for any intestinal condition were excluded. It was desired to find out whether any of those admitted to hospital for complaints other than intestinal were harbouring parasites. Since these patients would leave hospital as soon as they recovered, they would then become healthy carriers, as regards the intestinal parasites present.

A certain number of male and female patients were selected, and fresh stools from them were sent to the laboratory on alternate days for three weeks; on the intermediate days a similar series of an equal number of patients was sent. Two series of patients could thus be dealt with at the same time, or rather during the same period, the stools from one series being brought to the laboratory on Mondays, Wednesdays and Fridays, and those from the other on Tuesdays, Thursdays and Saturdays. Since no specimens were sent up on Sundays, each case was examined on the first, third, fifth, eighth, tenth, twelfth, fifteenth, seventeenth, and nineteenth days.

As none of the patients showed any signs of intestinal infection they were not under any treatment for the condition even when protozoal infection was detected, so that the natural course and variations could be followed during the period of examination.

As Dobell (1917) has stated: 'A minimum of six examinations per case should be adopted (it is an arbitrary number), no case being regarded as free from infection [he is speaking of *Entamoeba histolytica*] unless it has been examined six times with negative results. Untreated cases may be examined on any six days convenient to the examiner, since there is no evidence of periodicity in the occurrence of positive or negative examinations. Since the distribution appears to be at random, the chances of finding the infection, if present, are as great for any one day as any other.'

The case J. T. affords an example in which infection with *E. histolytica* was not detected until the last examination of all; six examinations would have failed to find this one.

The period of three weeks being decided upon, each patient's stools, if the actions were regular, were examined on nine occasions. Cropper and Row's concentration method was adopted, and was found to facilitate matters greatly when later we came on to the

mensuration of the cysts. There is no need to detail the method; suffice it to say that after concentration three separate specimens were examined from each before the stool was pronounced negative for the day.

Examination for helminth ova was also made on the first day that the stools were sent; if these were found, no further search was made for them on subsequent occasions, as the percentage of cases infected with these ova has been given in detail in my reports from Jamaica for several years, totalling over 40,000 specimens. If, however, none were found on the first day, their presence was noted when one came across them later in searching for protozoal cysts.

The tables appended show the distribution of the various parasites found, the cases being arranged according to age. It will be seen that the stools from one hundred and two patients have been submitted to examination, of which fifty-three were males and forty-nine females.

In twenty-one of the forty-nine female cases the *Entamoeba coli* was found during these examinations, and in six the *E. histolytica*. It will be noticed that in only one of these was the latter found without the former. Cysts of *Giardia intestinalis* were found alone in four instances, and in combination with other forms in eleven. *Chilomastix mesnili* was met with seven times and *Balantidium coli* once only.

Comparing these figures with the numbers found among the fifty-three male cases: *E. histolytica* was found in nine, *E. coli* in twenty-seven, *G. intestinalis* in twenty-one (in four of these they were present alone), *C. mesnili* was found in six, and *B. coli* in one.

Thus, out of the total of one hundred and two patients whose stools were examined, *E. coli* was found in forty-eight, or just over 47 per cent.; *E. histolytica* in fifteen, or 14·7 per cent.; *G. intestinalis* in thirty-six, or 35·29 per cent.; *C. mesnili* in thirteen, or 12·74 per cent.; and *B. coli* twice.

Cercomonas sp. occurred fairly frequently, but no record was kept of this. It is seen in a considerable number of the ordinary routine specimens sent to the laboratory for examination for ankylostome ova.

These proportions, when we consider that none of the patients gave any history, at all events recent, of intestinal troubles, are very

high, and it was my intention to continue the investigation to see whether subsequent series maintained this high percentage, but my transfer to Hong Kong has prevented this.

Before considering each of these protozoa in greater detail, it will be well to note the criteria made use of in distinguishing the *coli* and the *histolytica* cysts; those of *Giardia* and *Chilomastix* need no description. As regards the points relied upon in differentiating *coli* from *histolytica* cysts, as is well known, it is the general summation of various characters which enables a definite diagnosis to be made in almost every case; no single character considered alone will suffice for a decision. The points are:—

1. Size.
2. Nuclei: (*a*) number, (*b*) character and arrangement of the chromatin.
3. Cytoplasm.
4. Inclusions: (*a*) chromatoid bodies, (*b*) vacuoles.
5. Cyst wall.
6. Shape.

1. *Size.* The vast majority of *histolytica* cysts have a diameter between 5μ and 15μ , and of these there are said to be two chief strains met with, namely, 'small,' between 6μ and 9μ , with an average diameter of 7.7μ , and the 'ordinary,' between 10μ and 14μ , with an average of 12.6μ .

Coli cysts vary between wider limits, namely, 11μ to 35μ , the commonest being between 14μ and 22μ , so that difficulties under this head are only likely to arise in differentiating between a large *histolytica* and a small *coli* cyst.

2. *Nuclei:* (*a*) Number. In *histolytica* they may vary from one to four. Malins Smith states that more than half are quadrinucleate, while one-third are uninucleate. In contradistinction to this, more than four-fifths of *coli* cysts contain eight nuclei, and only about 10 per cent. are quadrinucleate, or less; occasionally a cyst with sixteen nuclei may be met with. It would appear that the consistence of the stool has some influence; thus, it is stated that in loose stools about 60 per cent. of the cysts contain eight nuclei, in semi-formed between 80 and 90 per cent., and in formed stools between 90 and 95 per cent. Binucleate cysts are found in about 7 per cent., and quadrinucleate in 3 per cent.

(b) Character and arrangement of the nuclear chromatin. The situation of this is, in either case, peripheral, but in *histolytica* it consists of smaller granules and is distributed fairly evenly, whereas in *coli* it is in larger masses or small blocks less evenly distributed, and therefore outlines the nucleus more definitely than is usually the case in *histolytica*.

3. *Cytoplasm*. This is of a greenish hue in a fresh specimen of *histolytica* and is not uniform in appearance, whereas in *coli* the uniformity is greater, the colour is pale and more of a greyish tint.

4. *Inclusions*: (a) Chromatoid bodies. These are better seen in fresh saline specimens than in preparations put up with Weigert's iodine. In *histolytica* they are found in about 30 per cent. of the cysts, are rod-shaped, with blunt, square or rounded ends; whereas they are less commonly seen in *coli*, only about one in twenty containing them, they are more irregular, are often pointed at the end, or 'splintered.' The value of chromatoid bodies in diagnosis is variable, for they may be absent from two-thirds of the cysts.

(b) Vacuoles. These are fairly often seen in *histolytica*, may be multiple, and usually have an ill-defined contour and stain faintly with iodine; in contradistinction the vacuoles of *coli* are rarely multiple, have a sharply defined edge, and stain more deeply with iodine.

5. *Cyst wall*. This is usually thinner in *histolytica* than in *coli*, and the latter sometimes appears to have a thin second contour; these points, however, are far from distinct, and are of minor importance as aiding diagnosis.

6. *Shape*. *Coli* is stated to be less frequently asymmetrical than is *histolytica*, but one comes across cases in which quite a considerable proportion of the *coli* cysts are asymmetrical; this was particularly noticed in one of the patients in my series.

When the majority of these points are in evidence there is no difficulty in diagnosis, but one may meet with cysts which have two or four nuclei, are ill-defined as to colour and uniformity of the cytoplasm (as stated by Matthews and Malins Smith), have no chromatoid bodies, no vacuoles, and not a sufficiently distinctive arrangement of the peripheral chromatin; in such cases certain diagnosis is not possible, but fortunately these are rare.

ENTAMOEBA COLI CYSTS

These were present, as already stated, in 47 per cent. of the one hundred and two cases examined; there was a slightly larger proportion found among males, viz., twenty-seven out of fifty-three (in the females twenty-one out of forty-nine). Since at least five hundred cases should be examined before any reliable inferences can be drawn as to incidence, it is very probable that further examinations would alter this preponderance. As shown in the table, it was the only one found in five cases of the males and in eight of the females; in conjunction with others it was more often met with. In some instances the infection was multiple; thus, in two of the males and one of the females there were *Ankylostoma*, *Ascaris*, *Trichiuris*, *coli*, *histolytica*, *Giardia* and *Chilomastix*, without causing any apparent abdominal or intestinal disturbance. •

No age seems to be exempt; thus, the cysts were found in a boy of 9 years of age and in a man of 68 years, in a girl of 13 and a woman of 56. None were found in the five women whose ages exceeded this, probably a mere coincidence.

It is interesting to remark that the nearest approach to the proportion of *coli* infection found in this series of natives examined (namely, 47 per cent.) was noted by Matthews and Malins Smith in England among asylum patients (45.9 per cent.). For those who are acquainted with the West Indian native, the obvious inference would form a subject of acrimonious if not fruitful debate.

Mention has already been made of the irregularity of distribution of the cysts of *coli* in the faeces, resulting in the finding of several in one specimen and none in others in the same stool; but, by examining larger amounts and concentrating, as I tried to do, the effects of this irregularity have been reduced. The fact must also be borne in mind that the cysts may appear intermittently and be found in nearly all the preparations made one day, but absent on another in spite of the careful examination of many preparations. Several of the cases given in the table bear out this point. Thus, in No. 52 of the males no cysts were found until the middle of the third week of examination, and in No. 16 they were seen on the first day in conjunction with *histolytica*, but not again, although the latter was found once subsequently. Other instances of intermittency

among the males are Nos. 4, 6, 15, 18, 49. More cases of a single finding of this variety of cyst occurred among the women, namely, Nos. 18, 25, 9, 41, 27, 3, when they were seen at the first, third, fifth and sixth examinations only. In Nos. 42 and 24 they were not seen until the seventh and eighth examinations respectively, and, although there was infection in No. 22 with *coli*, *histolytica*, *Giardia* and *Chilomastix*, the first-named was found on one occasion only.

It has been stated by Dobell that 'in a series of cases in which the mean number of examinations per case is three, not more than two-thirds, and possibly not more than half, will be detected.' Taking the first three examinations in this series of cases, there were detected fourteen among the females and eighteen among the males, a total of thirty-two out of the forty-eight in whom these cysts were present—exactly two-thirds.

Matthews and Malins Smith found that six examinations give for *histolytica* about three times the number of positive results obtained by one examination (23 per cent. in place of 7·8 per cent.), and for *coli* 20·6 per cent. from one examination became 59·8 per cent. by subsequent ones.

In my series, five only of the twenty-two positive cases among the females were detected at the first examination (less than one in four), and ten of the men, giving a total of fifteen out of forty-eight in spite of the concentration methods.

ENTAMOEBA HISTOLYTICA CYSTS

The cysts of *histolytica* are usually more regularly distributed than those of *coli*, though less so than those of *Giardia*. A negative record may, as Dobell states, arise either from their having a localised distribution and the part containing them not being submitted to examination, or to their being few in number and so overlooked. He offers an explanation as to the uniformity or localisation of distribution in the site of infection; if the upper part of the large intestine is affected, the faeces here being more or less fluid the cysts are fairly evenly distributed, and when solidification of the faeces occurs lower down the cysts remain scattered through the mass, but, if the lower part is affected, the faeces are already practically solidified and the cysts from the ulcerated surface are thus more superficially distributed

and also localised to those parts of the contents which have been in contact with the infected, ulcerated surface.

There would seem to be no periodicity in the appearance of cysts of *histolytica* in the faeces. Owing to the scarcity or to the localised distribution a negative record must not be taken to mean non-infection, unless a large number of examinations are made. Three negative examinations certainly do not warrant a negative report. Thus, only three of the cases among the females were discovered in my series in the first three examinations and not a single one at the first, in spite of the concentration method, showing most emphatically the uselessness of a negative single finding. Among the males only two were found at the first examination, and only six in the first three. Of the men and women together, only nine out of fifteen were discovered in the first three examinations. At the fourth one more was found, another at the fifth, three more at the sixth, and one not until the last time of examination.

The tables show also the irregularity in the days of appearance of the cysts of *histolytica* in the faeces; thus, amongst the men they were noted at the first and seventh; first, second, eighth and ninth; second, third, fourth, fifth, sixth and ninth; second, fourth and sixth; second and third only, second and sixth; and so on. Among the women on the second only; the fourth only; the fifth and ninth; the second, third and seventh; the second, fifth, sixth and seventh.

These patients were not being treated for the presence of these cysts, for none of them showed any clinical symptoms attributable thereto, and the mere presence of them does not imply amoebic dysentery either present or past, and certainly does not warrant specific treatment. The danger is more, of course, for others, for, though causing no symptoms in the host, they may nevertheless produce acute dysentery in another.

In this small series of one hundred and two cases it is seen that a larger number of *histolytica* carriers was found amongst the men than the women, in the proportion of three to two. Age appears to have no significance; thus, of the females one was aged 13, two were 28, one each at 30, 50 and 56 years. Of the men the youngest was 23, then came one at 25, one each at 29, 30, 31 and 32, two at 35 and one at 52 years; the only point which may be mentioned is that seven of the fifteen were found in patients during the third decade.

The importance of this infection with *histolytica* is great. From an examination of a large number of cases, Dobell stated that the incidence of infection does not appear to be conspicuously greater among the cases arriving at the general hospitals for treatment than among those reaching their final depôts after such treatment. It would seem, therefore, that the treatment which most of the dysenteric patients had received had not been sufficient to rid them of their infections. This refers to patients who suffer or have suffered from an attack of dysentery. Seeing that the infection is high in my series of patients who had not been abroad (*i.e.*, outside Jamaica) and who showed no clinical symptoms of intestinal mischief, there is every likelihood of greater spread now that large numbers of the contingents sent to the war from that island have returned, and that several of them suffered from dysentery in Egypt and elsewhere. Further, 'Egypt and its neighbouring lands are notorious centres of amoebic infection.' Dobell has also shown that passage through an infective area, by affording an opportunity of exposure to infection with *histolytica*, resulted in the acquisition of infection by a large number of individuals. The incidence of infection in men returning from Egypt and Gallipoli was not conspicuously higher among those who were classified as 'dysenterics' than among those invalided for other reasons. This is very applicable to the men who went from Jamaica, for many (if not most) of them served in Egypt, and some, at least, must have brought back infection with them.

As a matter of fact, the danger of spread is greater there than at home, for many of those harbouring the cysts appear to be in perfect health, are able to undertake their regular duties, associate freely with their fellowmen, and may spread the disease. Also the duration of carriage in a healthy carrier is not known, and would appear to be almost indefinitely prolonged; though there are intervals when the condition clears up, still this disappearance is only temporary. The two main safeguards against spread are a good sewerage system and abatement of the fly nuisance. Except in Kingston itself, and in parts only of the city, there is no proper sewerage system, the street gutters constituting the sewer for many. As regards the fly question, this is always a difficult problem in the tropics, and since we know that flies can take up *histolytica* cysts, pass them unchanged through their bodies and so infect food, the danger is clearly a very real one.

Wenyon and O'Connor's (1917) remarks on the fly question may be briefly quoted here:—

1. Flies readily take up encysted and other forms of protozoa into their intestines.

2. Encysted forms remain in the intestines of the fly as long as there is any faecal matter. If prevented from feeding they may retain the cysts for as long as forty-two hours; if feeding is allowed, they do not retain the cysts as long, and the flies may deposit material (and with it cysts) ingested only five minutes previously.

3. Cysts do not degenerate to any extent in the intestines of the fly, but readily pass unaltered.

GIARDIA INTESTINALIS

There is no proof that *Giardia* is pathogenic, at any rate in adults. It has been found in a considerable number of instances in this series, sometimes in a free state, sometimes encysted and in very large numbers. Its presence has been noted in thirty-six of the one hundred and two cases, or 35·29 per cent.; of these twenty-one were amongst the fifty-three males and fifteen amongst the forty-nine females. This, again, is a higher percentage than was found in cases recorded by Dobell, Wenyon and O'Connor. The first-named found 27·3 per cent. with a minimum of six examinations, but states that this was probably not more than three-fourths of the real number.

This parasite is usually found more frequently in patients suffering from diarrhoea, but it is probably nearer the truth to say that the diarrhoea or loose action is the 'cause' of the detection of the infection than *vice-versa*, that the infection is the 'cause' of the diarrhoea. Two reasons may be offered to account for the high percentage of infection in my series; firstly, that in order to ensure the procuring of specimens many of the patients were given salines, thus producing a loose action, and secondly, the concentration method allowed of the discovery of the organism in cases where they would otherwise have been so few as to be overlooked.

In reports of examinations carried out in England, it has usually been found that *Giardia* was much more common in children, so

much so that Matthews and Malins Smith suggest that this flagellate is mainly a parasite of children and that it may disappear from the intestine in course of time.

In my series it was found in all cases examined (six) below the age of 15 years, but was also present in others of 20, 56, and 60 years of age (five out of eight in the sixth decade); among the females it was found in two of the three under 15 years of age, but also in seven out of seventeen between 21 and 30 years, and in one each at 37, 48 and 56 years.

CHILOMASTIX MESNILI

Cysts of this parasite were found six times among the males and seven among the females, giving a total percentage of 12.74. In some instances they were exceedingly numerous, occurring not only in every field, but sometimes more than one in the field, the concentration method accounting in part for this. They are probably of no pathogenic significance.

Lastly, it may be mentioned that *Balantidium coli* was found twice: in a woman of 56 and a man of 22 years of age, in the latter as the only parasite detected, in the former associated with *E. coli*.

The appended tables give succinctly the chief points in connection with this investigation. The patients have been arranged in order of age for ease of reference.

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B. = *Balantidium coli*. *C.* = *Entamoeba coli*. *Ch.* = *Chilomastix mesnili*. *G.* = *Giardia intestinalis*. *H.* = *Entamoeba histolytica*. ... signifies that the stool was not obtained. — signifies negative examination.

No.	Initials	Age	Disease	Helminthiasis			Protozoa											
				Ancylostoma	Acaris	Trichuris	1	2	3	4	5	6	7	8	9			
1	C. H.	9	Fracture ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
2	R. F.	9	Fracture ...	—	—	—	G.	G.	—	—	—	—	—	—	G.	—	G.	—
3	V. H.	9	Fractured Tibia ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
4	C. M.	13	Hernia ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	L. B.	13	Nephritis ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	L. S.	15	Conjunctivitis ...	+	+	+	C.G.	C.G.	—	—	—	—	—	—	—	—	—	—
7	C. L.	17	Abscess of Leg ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
8	C. D.	20	Bell's paralysis ...	+	+	—	—	—	—	—	—	—	—	—	—	—	—	—
9	E. R.	20	Syphilis ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	C. C.	21	Fracture ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	R. B.	22	Paralysis (right arm) ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	R. W.	22	Lacerated wound of eye	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
13	E. H.	23	Fracture ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
14	W. L.	23	Ancylostomiasis ...	+	+	—	—	—	—	—	—	—	—	—	—	—	—	—
15	S. M.	24	Syphilis ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
16	N. S.	25	Chronic Ulcer : amputation of leg	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	D. M.	26	Laceration of eye...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	G. J.	26	Malaria ...	+	+	+	—	—	—	—	—	—	—	—	—	—	—	—
19	G. S.	26	Dermatitis ...	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	P. E.	27	Hernia ...	—	—	—	G.	G.	—	—	—	—	—	—	—	—	—	—
21	E. W.	28	Syphilis ...	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22	C. F.	29	Ophthalmia ...	+	+	—	—	—	—	—	—	—	—	—	—	—	—	—
23	J. R.	29	Lymphadenitis ...	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24	S. A.	30	Fracture ...	+	+	—	—	—	—	—	—	—	—	—	—	—	—	—
25	N. T.	31	Nephritis ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	R. W.	31	Hernia ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

